

Types of Mountains, Classification, Examples, Characteristics, Location

October 30, 2025 • vajiramandravi.com



Mountains are natural elevations of the Earth's surface rising abruptly from their surroundings, often with steep slopes and significant height. They play a vital role in shaping the Earth's climate, biodiversity, and human settlements. According to the United Nations Environment Programme (UNEP), mountains cover around 27% of the world's land area and are home to nearly 15% of the global population. In India, major mountain ranges influence monsoons, rivers, and ecosystems, making them critical for geography and environment.

Types of Mountains

Mountains are classified based on their origin, formation processes, age, location, etc. The major types of mountains include Tectonic Mountains, Volcanic Mountains and Residual Mountains. Each type is formed due to distinct geological activities like plate movement, volcanic action, or erosion.

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Types of Mountains Classification

The Mountains can be classified on the basis of several parameters. The major basis of classification is listed below:

1. Types of Mountains Based on Location
2. Types of Mountains Based on Mode of Origin
3. Types of Mountains Based on Age of Origin

Types of Mountains Based on the Location

Mountains can be classified according to their location of occurrence, which helps in understanding their geographical setting, climatic influence, and geological evolution. Broadly, they are divided into Continental Mountains and Oceanic Mountains. Continental mountains further include Coastal Mountains and Inland Mountains, while oceanic mountains are those that rise from the ocean floor. Each type exhibits unique features, formation processes, and global as well as Indian examples.

1. Continental Mountains

Continental mountains are formed on continental landmasses and represent the most common type of mountain systems on Earth. They play a major role in influencing continental climate, river systems, and biodiversity. These are of two major subtypes- **Coastal Mountains** and **Inland Mountains**.

(a) Coastal Mountains

Coastal mountains lie along the edges of continents, generally parallel to the coastline. They often act as barriers to moisture-laden winds, influencing rainfall patterns and the distribution of vegetation. These mountains are usually formed due to tectonic activity, subduction zones, or volcanic processes near plate margins.

- **Characteristics:**

- Located close to or along the sea coast.
- Exhibit steep slopes on the seaward side and gentler slopes on the inland side.
- Often associated with active fault lines and volcanic activity.
- Rich in minerals and natural resources due to geological dynamism.

- **Examples:**

- Western Ghats (India): Stretching along the **Arabian Sea** coast, they influence monsoon patterns and are a **UNESCO World Heritage Site** for biodiversity.
- Eastern Ghats (India): Older and more eroded, lying parallel to the **Bay of Bengal**.
- Andes Mountains (South America): Formed due to the subduction of the Nazca Plate beneath the South American Plate.
- Rocky Mountains (North America): Extending along the western coast, shaped by tectonic uplift and volcanic activity.
- Atlas Mountains (Africa): Along the northwestern coast of Africa, representing folded mountain systems.

- **Geological Significance:** Coastal mountains act as natural barriers protecting inland areas from sea winds and cyclonic activities. They also influence river systems by acting as water divides and serve as reservoirs for **biodiversity** and minerals.

(b) Inland Mountains

Inland mountains are situated in the interior regions of continents, far from coastal influences. They generally arise due to continental collisions, volcanic activity, or erosional remnants of older mountain systems. These mountains often determine the drainage patterns, climatic divisions, and human settlements within a continent.

- **Characteristics:**

- Located deep inside continental interiors.
- Typically composed of older rock systems, often folded or faulted.
- Play a vital role in defining river basins and watershed regions.
- Experience extreme climates due to their distance from oceanic moderation.

- **Examples:**

- Himalayas (India): The world's youngest fold mountain system formed by the collision of the Indian and Eurasian plates.
- Aravalli Range (India): Among the world's oldest fold mountains, located in northwestern India.
- Ural Mountains (Russia): A natural boundary between Europe and Asia, composed of ancient crystalline rocks.
- Appalachian Mountains (USA): Ancient eroded mountains of eastern North America formed during the Paleozoic era.
- Kunlun and Tien Shan Mountains (China): Interior Asian ranges shaped by the same tectonic forces as the Himalayas.

- **Geological Significance:** Inland mountains play a key role in influencing continental climate, acting as barriers to air mass movement. They are also rich in minerals, forest resources, and hydropower potential. Their formation marks major tectonic events such as continental drift and plate convergence.

2. Oceanic Mountains

Oceanic mountains are those that rise from the ocean floor, often forming long chains known as mid-ocean ridges or volcanic island arcs. These are primarily formed by underwater volcanic activity, sea-floor spreading, or tectonic uplift. Although submerged, they shape oceanic currents, marine life distribution, and geological processes of the ocean crust.

- **Characteristics:**

- Located entirely below the ocean surface, though some peaks may emerge as islands.
- Formed mainly by volcanic eruptions and tectonic divergence at mid-ocean ridges.
- Composed of basaltic rocks rather than granitic continental crust.
- Host hydrothermal vents that support unique marine ecosystems.

- **Examples:**

- Mid-Atlantic Ridge: A continuous underwater mountain range formed by the divergence of the Eurasian and North American plates.
- East Pacific Rise: A major mid-ocean ridge located in the **Pacific Ocean** responsible for new oceanic crust formation.
- Hawaiian Islands (USA): Volcanic peaks formed due to a hotspot in the Pacific Plate.

- Ninety East Ridge (Indian Ocean): A linear underwater ridge formed by volcanic activity and tectonic movement.
- Carlsberg Ridge (Arabian Sea): Part of the Indian Ocean ridge system, important for studying sea-floor spreading.
- **Geological Significance:** Oceanic mountains play a crucial role in plate tectonics and earthquake distribution. They regulate oceanic circulation, influence global climate patterns, and provide insights into the Earth's internal processes. Many underwater mountains also hold vast reserves of manganese nodules, polymetallic sulphides, and other mineral resources.

Types of Mountains Based on the Mode of Origin

Mountains are classified on the basis of their mode of origin into three major categories: Tectonic (or Original) Mountains, Circum-Erosional (Residual or Relict) Mountains, and Volcanic Mountains. This classification helps in understanding how various geological processes such as plate tectonics, volcanic activity, erosion, and folding shape the Earth's surface. Each type represents a distinct stage of the Earth's geomorphic evolution and contributes to regional topography, mineral wealth, and climatic influence.

1. Tectonic or Original Mountains

Tectonic mountains are formed by crustal movements and deformation caused by the interaction of lithospheric plates. They are also known as Orogenic mountains and represent regions of intense folding, faulting, and uplift due to compressional forces. These mountains are the most common and geologically significant on Earth.

Tectonic mountains are further classified into:

- Fold Mountains
- Block Mountains
- Dome Mountains

(a) Fold Mountains

Fold mountains arise due to horizontal compression of the Earth's crust, which bends and folds sedimentary rock layers into wave-like structures. They are typically located along convergent plate boundaries where two plates collide.

- **Characteristics:**

- Consist of parallel ridges (anticlines) and valleys (synclines).
- Formed mainly from sedimentary rocks deposited in geosynclines.
- Highly elevated, young, and seismically active regions.
- Rich in minerals and serve as sources of perennial rivers.

- **Examples:**

- Himalayas (India): Formed by the collision of the Indian and Eurasian plates; still rising at ~5 mm per year (Geological Survey of India, 2022).
- Alps (Europe): Created by the convergence of the African and Eurasian plates.
- Andes (South America) and Rockies (North America) are also major fold mountain systems.

(b) Block Mountains

Block mountains, or fault-block mountains, form when large crustal blocks are displaced vertically along fault lines due to tensional forces. The uplifted blocks are called horsts, and the lowered regions are called grabens.

- **Characteristics:**

- Formed by faulting, not folding.
- Exhibit steep slopes and flat-topped summits.
- Usually found in regions of crustal tension and rifting.
- Associated with earthquake activity due to fault movement.

- **Examples:**

- Vindhya and Satpura Ranges (India): Classic block mountains formed due to faulting in central India.
- Black Forest (Germany) and Vosges Mountains (France): European examples formed by rift faulting.
- Sierra Nevada (USA): Formed by normal faulting along the North American Plate.

(c) Dome Mountains

Dome mountains are created when magma intrudes between rock layers and pushes the overlying strata upwards, forming a dome-shaped structure. However, the magma does not reach the surface, and erosion later exposes the core.

- **Characteristics:**

- Rounded, dome-like appearance with steep slopes.
- Often composed of granitic or metamorphic rocks.
- Result from igneous intrusion rather than surface volcanism.
- Generally small in areal extent compared to fold mountains.

- **Examples:**

- Velikonda Range (Eastern Ghats, India) shows dome-like structures.
- Black Hills (USA) and Adirondack Mountains (USA) are classic examples of dome mountains.
- Uluru (Australia) is an isolated monolithic dome.

2. Residual Mountains

Circum-erosional mountains, also known as Residual or Relict Mountains, are formed due to long-term erosion and denudation of pre-existing mountains. Wind, water, glaciers, and chemical weathering gradually wear away softer materials, leaving behind resistant rock masses that form rugged topography.

- **Characteristics:**

- Formed from remnants of ancient mountain systems.
- Composed mainly of hard, resistant rocks like granite or gneiss.
- Have rounded tops and low elevation due to prolonged weathering.
- Represent old-age landforms with little tectonic activity.

- **Examples:**

- Aravalli Range (India): Among the world's oldest mountain systems, formed during the Precambrian era (~2.5 billion years ago).

- Nilgiri Hills (India): Residual highlands in southern India.
- Appalachian Mountains (USA) and Pennines (UK): Once high fold mountains, now eroded to low ranges.
- **Geological Significance:** These mountains reveal the ancient tectonic history of the Earth and serve as valuable sources of minerals, metals, and geological data on early crustal evolution.

3. Volcanic Mountains

Volcanic mountains are built by successive eruptions of lava, ash, and volcanic debris from a vent in the Earth's crust. Over time, the accumulation of these materials creates a cone-shaped mountain. Such mountains are associated with divergent or convergent plate boundaries and hotspots.

- **Characteristics:**
 - Conical shape with a central crater or vent.
 - Composed primarily of basalt or andesite rocks.
 - Many are active or dormant volcanoes with high geothermal potential.
 - Found both on continents and ocean floors.
- **Examples:**
 - Mount Fuji (Japan): An iconic stratovolcano formed at the Pacific and Eurasian plate boundary.
 - Mount Vesuvius (Italy) and Mount Etna (Sicily): European volcanic mountains of historical importance.
 - Barren Island (India): India's only active volcano, located in the Andaman Sea.
 - Mauna Loa (Hawaii): The largest shield volcano in the world.
- **Geological Significance:** Volcanic mountains play a key role in crustal formation, mineral enrichment, and atmospheric evolution. They also influence local weather and soil fertility.

Types of Mountains Based on the Age of Origin

Mountains can also be classified based on the geological period during which they were formed. The age of mountains helps geologists and geographers understand the Earth's tectonic history, the processes of orogeny (mountain building), and the landscape evolution over time. According to geological studies, especially data from the Geological Survey of India (GSI) and US Geological Survey (USGS), mountains are broadly classified into four major systems based on their age of origin: Precambrian Mountains, Caledonian Mountains, Hercynian (Variscan) Mountains, and the Alpine Mountain System.

1. Precambrian Mountains (>570 million years old)

The Precambrian mountains are the oldest mountain systems on Earth, formed before the Cambrian period, over 570 million years ago. These ancient ranges have undergone extensive erosion and weathering, leaving behind residual and relict formations. They represent some of the most stable geological structures and form the basement shields of continents.

- **Characteristics:**
 - Extremely old and highly denuded.
 - Composed mostly of igneous and metamorphic rocks.
 - Represent the roots of ancient orogenies.

- Generally low in elevation due to erosion over geological time.
- Rich in metallic minerals such as iron, copper, and manganese.

- **Examples:**

- Aravalli Range (India): One of the world's oldest fold mountains, dating back to the Precambrian era, extending across Rajasthan and Haryana.
- Dharwar Hills (Karnataka, India): Part of the Peninsular Shield with rich mineral deposits.
- Canadian Shield (North America): Represents the eroded roots of ancient mountain systems.
- Brazilian Highlands and Western Australian Plateau: Other global examples of ancient mountain remnants.

2. Caledonian Mountains (About 400 million years old)

The Caledonian orogeny took place during the Silurian to early Devonian periods (approximately 400-450 million years ago). These mountains were formed due to the collision of ancient continental plates, resulting in large-scale folding and faulting. The name comes from "Caledonia," the ancient name for Scotland, where these features are well developed.

- **Characteristics:**

- Formed during the closure of the Iapetus Ocean.
- Moderately eroded due to their old age.
- Found mostly in the Northern Hemisphere.
- Composed largely of metamorphic and sedimentary rocks.

- **Examples:**

- Scandinavian Mountains (Norway and Sweden)
- Scottish Highlands (UK)
- Appalachian Mountains (Eastern USA)- their older parts show Caledonian features.
- Dovrefjell Mountains (Norway)

- **Geological Significance:** Caledonian mountains represent the first global-scale orogeny after the breakup of early continental plates, shaping the early continents of Laurasia and Baltica.

3. Hercynian or Variscan Mountains (About 250-300 million years old)

The Hercynian or Variscan orogeny occurred during the Carboniferous and Permian periods, around 250-300 million years ago. These mountains formed when the ancient supercontinents Laurasia and Gondwana began to converge, closing the Rheic Ocean.

- **Characteristics:**

- Formed by complex folding and faulting processes.
- Moderately eroded, forming highlands and plateaus.
- Rich in coal and mineral resources due to associated sedimentation.
- Found primarily in Europe and parts of Asia.

- **Examples:**

- Vosges and Black Forest (Europe)

- Ural Mountains (Russia)- forming a natural boundary between Europe and Asia.
- Appalachian Mountains (USA)- the central parts show Hercynian reactivation.
- Central Plateau of France (Massif Central)
- **Geological Significance:** These mountains mark an important phase in Earth's crustal evolution, linking ancient geological events to modern continental configurations.

4. Alpine Mountain System (<60 million years old)

The Alpine orogeny represents the youngest mountain-building phase, occurring during the Tertiary period (around 60 million years ago). These mountains are still tectonically active, with ongoing uplift and seismic activity. The term "Alpine" comes from the Alps of Europe, but this system includes several young fold mountains across the world.

- **Characteristics:**
 - Formed by continental collision and subduction of major tectonic plates.
 - Steep, rugged, and high peaks with active glaciers.
 - Contain many of the world's highest mountain ranges.
 - Geologically young, less eroded, and highly unstable.
- **Examples:**
 - Himalayas (India, Nepal, Bhutan, China): Formed by the collision of the Indian and Eurasian plates, still rising at a rate of a few millimetres per year.
 - Alps (Europe): Created by the collision of the African and Eurasian plates.
 - Andes (South America): Formed by subduction of the Nazca Plate beneath the South American Plate.
 - Rocky Mountains (North America): Formed during the Laramide orogeny, part of the Alpine phase.
- **Geological Significance:** The Alpine system is crucial for understanding plate tectonics, earthquakes, and volcanism. These mountains also regulate global climate, river systems, and human settlement patterns.

Mountains Importance

Mountains are crucial for ecological balance, water supply, and human livelihood. They regulate climate, house biodiversity, and act as natural barriers. Key Functions:

1. Water Reservoirs: Source of 60% of world's freshwater (UN Water, 2021).
2. Climate Regulation: Influence wind patterns and rainfall.
3. Biodiversity Hotspots: Contain nearly half of world's biodiversity.
4. Cultural Significance: Home to ancient civilizations and spiritual centers.
5. Economic Value: Support tourism, minerals, and hydroelectric power.

Types of Mountains UPSC

Mountains, whether fold, block, volcanic, or residual, represent Earth's dynamic geological processes and ecological diversity. From the majestic Himalayas to the ancient Aravallis, they influence weather, rivers, and biodiversity crucial for life. For India, sustainable mountain management is not only an environmental priority but also a key factor in long-term economic and ecological stability.

Source: <https://vajiramandravi.com/current-affairs/types-of-mountains/>

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